



## PRODUCT SPECIFICATION

*Part Number*

PT322435-TLMWD-E32B

|                      |  |
|----------------------|--|
| CUSTOMER             |  |
| CUSTOMER PART NUMBER |  |
| DESCRIPTION          |  |
| APPROVED BY          |  |
| DATE                 |  |

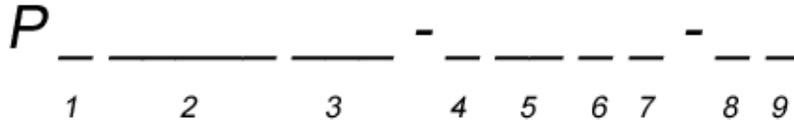
**1. Table of Contents**

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**3. Module Numbering System**



**1. LCD TYPE**

C = Character  
 G = Graphic  
 T = TFT  
 COG = Chip on Glass  
 COF = Chip on Flex  
 TAB = Tape Automated Bonding

**6. BACKLIGHT COLOR**

B = Blue  
 Y = Yellow  
 G = Green  
 S = Yellow-Green  
 W = White

**2. LENGTH x WIDTH**

*in pixels. Zeroes removed from this section.*

**7. VIEWING DIRECTION**

D = 6 o'clock  
 U = 12 o'clock  
 F = Full v/a

**3. DIAGONAL DIMENSION**

*Product size in inches*

**8. A ~ Z CODE**

*Assigned by P-tec*

**4. LCD MODE**

T = TN

**9. TOUCH PANEL TYPE**

None = Blank  
 R = Resistive  
 C = Capacitive

**5. POLARIZER**

LF = Transflective  
 LM = Transmissive

**10. SPECIAL CHARACTERS**

*Characters assigned by P-tec to reflect special customer requirements*

**4. Application**

This specification is applied to the 3.5 inch QVGA supported TFT-LCD module With Transparent Touch Panel, and can display 262k colors. The module is designed for PMP, GPS, DMB, other electronic products which require flat panel display of digital signal interface, and used as the input devices for general electric appliances via both finger and pen-entry.

**5. Features**

- QVGA (320×240 pixels) resolution.
- CCIR656 data format (640RGB & 720RGB).
- Serial Peripheral Interface (SPI).
- Line inversion mode with stripe type.
- On-chip voltage generator
- Transparent Touch panel
  - 4-Wire
  - Analog Resistive
  - Chemical Strengthen

**6. General Specifications**

| Item                | Specifications   | Unit |
|---------------------|--|------|
| Screen Size         | 3.5 (Diagonal)   | inch |
| Display Format      | 320RGB(H)×240(V)   | dot  |
| Active Area         | 70.08(H)×52.56(V)  | mm   |
| Dot Pitch           | 0.073(H)×0.219(V)  | mm   |
| Pixel Configuration | RGB Vertical Stripe  | -    |
| Display Mode        | TN Type<br>Transmissive Mode<br>Normally White   | -    |
| Surface Treatment   | Anti-Glare and Hard Coating(3H)  | -    |
| Viewing Direction   | 6 O'clock<br>(The Gray Inversion will appear at this direction)  | -    |
| Outline Dimension   | 76.9(W)×63.9(H)×4.4(D)   | mm   |
| DC to DC circuit    | Build-in   | -    |
| Weight              | (42)   | g    |
| RoHS Compliance     | P-tec certifies this product to be in compliance with European Union Directive 2002/95/EC on the restriction of certain hazardous substances in electrical and electronic equipment. | -    |

**7. Absolute Maximum Ratings****7.1 Absolute Ratings of Environment**

| Item                  | Symbol          | Value |      | Unit | Note   |
|-----------------------|-----------------|-------|------|------|--------|
|                       |                 | Min.  | Max. |      |        |
| Storage Temperature   | T <sub>ST</sub> | -30   | +80  | °C   | (1)(2) |
| Operating Temperature | T <sub>OP</sub> | -20   | +70  | °C   | (1)(2) |

Note1: Background color changes slightly depending on ambient temperature.

This phenomenon is reversible.

Note2: Please refer to item of RELIABILITY.

**7.2 Electrical Absolute Ratings****7.2.1 TFT-LCD Module**

(Ta=25±2°C, GND=V<sub>SS</sub>=0V)

| Item                         | Symbol          | Value                |      | Unit | Note |
|------------------------------|-----------------|----------------------|------|------|------|
|                              |                 | Min.                 | Max. |      |      |
| Digital Power Supply Voltage | V <sub>CC</sub> | V <sub>SS</sub> -0.3 | 5.0  | V    | -    |

**7.2.2 Backlight Unit**

(Ta=25±2°C)

| Item            | Symbol         | Value |      | Unit | Note |
|-----------------|----------------|-------|------|------|------|
|                 |                | Min.  | Max. |      |      |
| Forward current | I <sub>f</sub> | -     | (30) | mA   | (1)  |
| Reverse voltage | V <sub>r</sub> | -     | (30) | V    | (1)  |

Note (1) Permanent damage to the device may occur if maximum values are exceeded or reverse voltage is loaded.



### 8. Electrical Characteristics

#### 8.1 TFT-LCD Module

(Ta=25±2°C)

| Item                         | Symbol          | Value              |      |                    | Unit | Note |
|------------------------------|-----------------|--------------------|------|--------------------|------|------|
|                              |                 | Min.               | Typ. | Max.               |      |      |
| Digital Power Supply Voltage | V <sub>CC</sub> | 2.5                | 3.3  | 3.6                | V    | -    |
| Input High Threshold Voltage | V <sub>IH</sub> | 0.8V <sub>CC</sub> | -    | V <sub>CC</sub>    | V    | -    |
| Input Low Threshold Voltage  | V <sub>IL</sub> | 0                  | -    | 0.2V <sub>CC</sub> | V    | -    |

(GND=V<sub>SS</sub>=0V)

| Parameter               | SYMBOL           | Condition              | Min | Typ   | Max  | Unit | Remarks |
|-------------------------|------------------|------------------------|-----|-------|------|------|---------|
| Digital Current         | I <sub>VCC</sub> | V <sub>CC</sub> = 3.3V | -   | 15.6  | 22.0 | mA   | (1)     |
| Total Power Consumption | PC               | -                      | -   | 51.48 | 72.6 | mW   | (1)     |

Note (1) The specified power consumption is under the conditions at V<sub>CC</sub>=3.3V, F<sub>V</sub>=60Hz, whereas a power dissipation check pattern below is displayed.

Black Pattern / 0 Gray



Active Area

**8.2 Backlight Unit**

(Ta=25±2°C)

| Item              | Symbol          | Value |        |      | Unit | Note |
|-------------------|-----------------|-------|--------|------|------|------|
|                   |                 | Min.  | Typ.   | Max. |      |      |
| LED Voltage       | VL              | -     | (19.5) | -    | V    | (1)  |
| LED Current       | IL              | -     | (20)   | -    | mA   | (1)  |
| Power Consumption | P <sub>BL</sub> | -     | (390)  | -    | mW   | (1)  |

Note (1) The driving design of backlight unit is dependent on serial consideration of six LEDs.

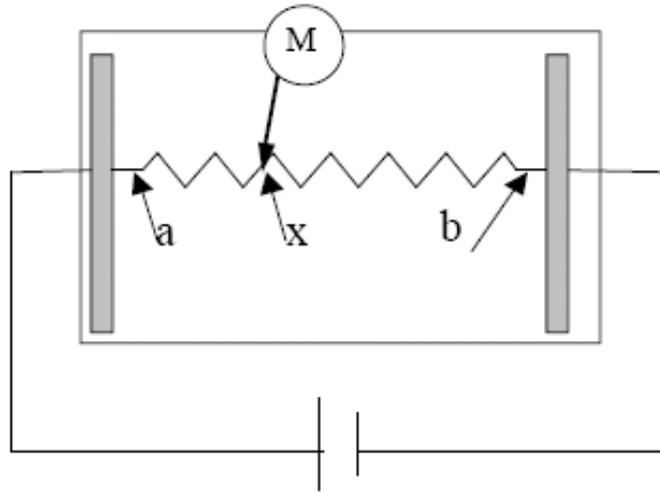
**8.3 Transparent Touch panel**

| Item                  |             | Value   |      |      | Unit | Note         |
|-----------------------|-------------|---------|------|------|------|--------------|
|                       |             | Min.    | Typ. | Max. |      |              |
| Operating Voltage     |             | -       | 5    | 7    | V    | -            |
| Terminal Resistance   | X-direction | 300     | -    | 900  | Ω    | At connector |
|                       | Y-direction | 300     | -    | 700  | Ω    | At connector |
| Insulation Resistance |             | ≥ 20MΩ  |      |      |      | at DC25V     |
| Chatting              |             | ≤ 10 ms |      |      |      | -            |
| Linearity             |             | ≤ 1.5%  |      |      |      | (1)          |

Note(1): Measurement condition of Linearity



Linearity Definition



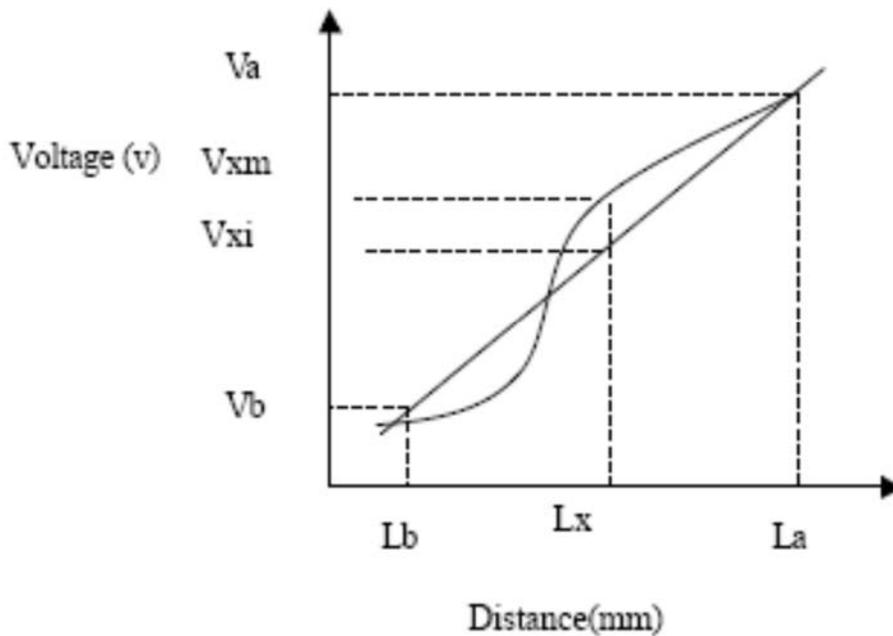
Va : maximum voltage in the active area of touch panel

Vb: minimum voltage in the active area of touch panel

X : random measuring point

Vxm: Actual voltage of Lx point

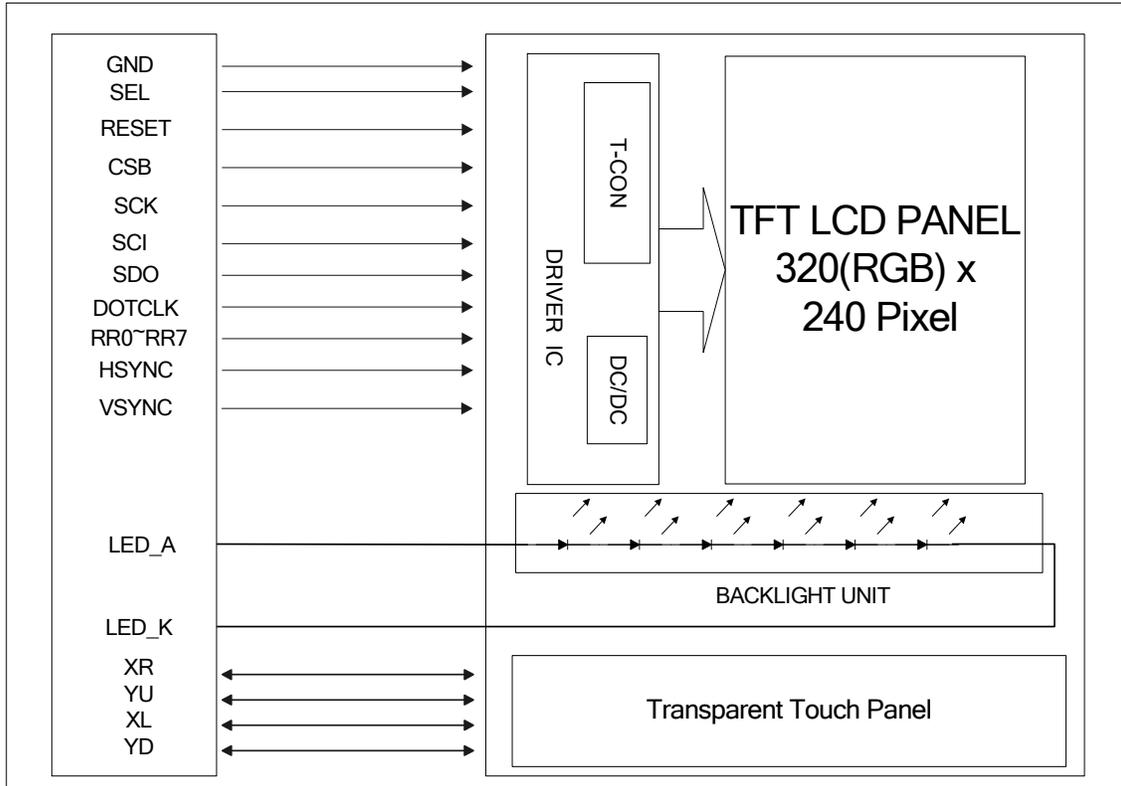
Vxi : Theoretical voltage of Lx point



$$\text{Linearity} : [\frac{1}{2}Vxi - Vxm] / (Va - Vb) * 100\%$$



### 9. Block Diagram



**10. Input / Output Terminals Pin Assignment****10.1 TFT-LCD Module**

| Pin No. | Symbol | I/O | Description       |                                  |
|---------|--------|-----|-------------------|----------------------------------|
| 1       | LED_K  | I   | LED_cathode       |                                  |
| 2       | LED_K  | I   | LED_cathode       |                                  |
| 3       | LED_A  | I   | LED_anode         |                                  |
| 4       | LED_A  | I   | LED_anode         |                                  |
| 5       | GND    | I   | Ground            |                                  |
| 6       | X1     | I   | RIGHT             |                                  |
| 7       | Y1     | I   | TOP               |                                  |
| 8       | X2     | I   | LEFT              |                                  |
| 9       | Y2     | I   | BOTTOM            |                                  |
| 10      | GND    | I   | Ground            |                                  |
| 11      | SEL    | I   | Pin11             | Define the input interface mode. |
|         |        |     | Pull High         | CCIR 656 data format (720RGB)    |
|         |        |     | Pull Low & NC     | CCIR 656 data format (640RGB)    |
| 12      | NC     | I   | No connection     |                                  |
| 13      | NC     | I   | No connection     |                                  |
| 14      | RESET  | I   | Reset             |                                  |
| 15      | CSB    | I   | CHIP SELECT       |                                  |
| 16      | SCK    | I   | Serial Clock      |                                  |
| 17      | SDI    | I   | Serial Data Input |                                  |
| 18      | TEST   | I   | No connection     |                                  |
| 19      | TEST   | I   | No connection     |                                  |
| 20      | TEST   | I   | No connection     |                                  |
| 21      | TEST   | I   | No connection     |                                  |
| 22      | TEST   | I   | No connection     |                                  |
| 23      | TEST   | I   | No connection     |                                  |
| 24      | TEST   | I   | No connection     |                                  |
| 25      | TEST   | I   | No connection     |                                  |
| 26      | TEST   | I   | No connection     |                                  |
| 27      | TEST   | I   | No connection     |                                  |
| 28      | TEST   | I   | No connection     |                                  |
| 29      | TEST   | I   | No connection     |                                  |
| 30      | TEST   | I   | No connection     |                                  |



| Pin No. | Symbol | I/O | Description                   |
|---------|--------|-----|-------------------------------|
| 31      | TEST   | I   | No connection                 |
| 32      | TEST   | I   | No connection                 |
| 33      | TEST   | I   | No connection                 |
| 34      | RR0    | I   | Data 0(LSB)                   |
| 35      | RR1    | I   | CCIR656 input data            |
| 36      | RR2    | I   |                               |
| 37      | RR3    | I   |                               |
| 38      | RR4    | I   |                               |
| 39      | RR5    | I   |                               |
| 40      | RR6    | I   |                               |
| 41      | RR7    | I   |                               |
| 42      | HSYNC  | I   | Horizontal synchronous signal |
| 43      | VSYNC  | I   | Vertical synchronous signal   |
| 44      | DOTCLK | I   | Data Colck                    |
| 45      | NC     | I   | No connection                 |
| 46      | NC     | I   | No connection                 |
| 47      | VCC    | I   | Digital Power                 |
| 48      | VCC    | I   | Digital Power                 |
| 49      | SDO    | I   | Serial Data Output            |
| 50      | NC     | I   | No connection                 |
| 51      | NC     | I   | No connection                 |
| 52      | NC     | I   | No connection                 |
| 53      | NC     | I   | No connection                 |
| 54      | NC     | I   | No connection                 |
| 55      | NC     | I   | No connection                 |
| 56      | NC     | I   | No connection                 |
| 57      | NC     | I   | No connection                 |
| 58      | TEST   | I   | No connection                 |
| 59      | GND    | I   | Ground                        |
| 60      | GND    | I   | Ground                        |

**11. Interface Timing****11.1 Input Signal Characteristics****11.1.1 CCIR 656 data format (640RGB)**

| PARAMETER       | SYMBOL           | MIN. | TYP.  | MAX. | UNIT |
|-----------------|------------------|------|-------|------|------|
| CLK frequency   | F <sub>osc</sub> | -    | 24.54 | -    | Mhz  |
| CLK period      | T <sub>osc</sub> | -    | 40.7  | -    | ns   |
| Data setup time | T <sub>su</sub>  | 12   | -     | -    | ns   |
| Data hold time  | T <sub>hd</sub>  | 12   | -     | -    | ns   |

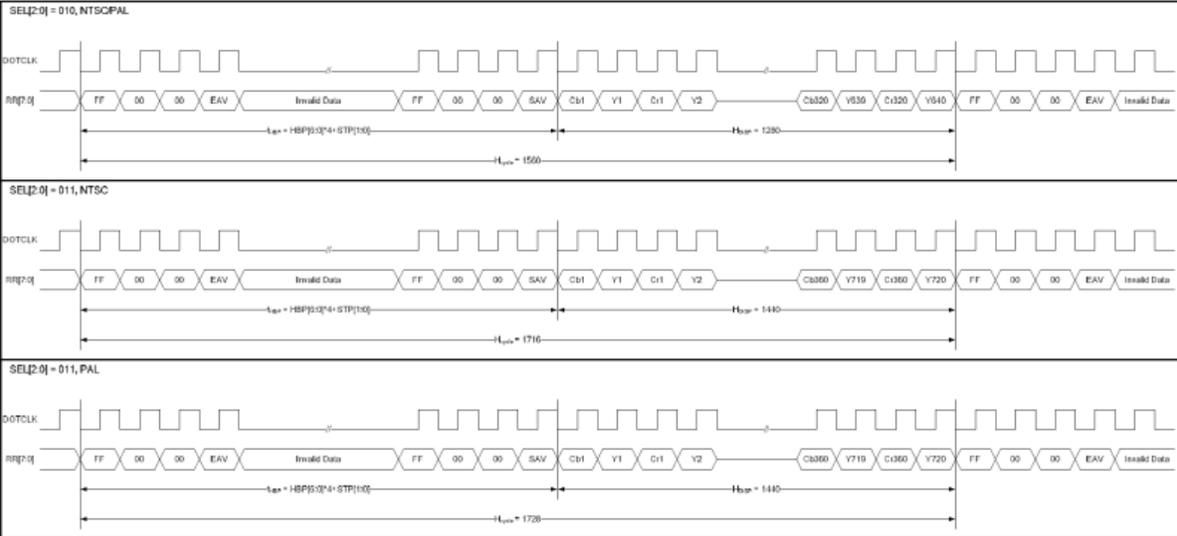
**11.1.2 CCIR 656 data format (720RGB)**

| PARAMETER       | SYMBOL           | MIN. | TYP. | MAX. | UNIT |
|-----------------|------------------|------|------|------|------|
| CLK frequency   | F <sub>osc</sub> | -    | 27   | -    | Mhz  |
| CLK period      | T <sub>osc</sub> | -    | 37   | -    | ns   |
| Data setup time | T <sub>su</sub>  | 12   | -    | -    | ns   |
| Data hold time  | T <sub>hd</sub>  | 12   | -    | -    | ns   |

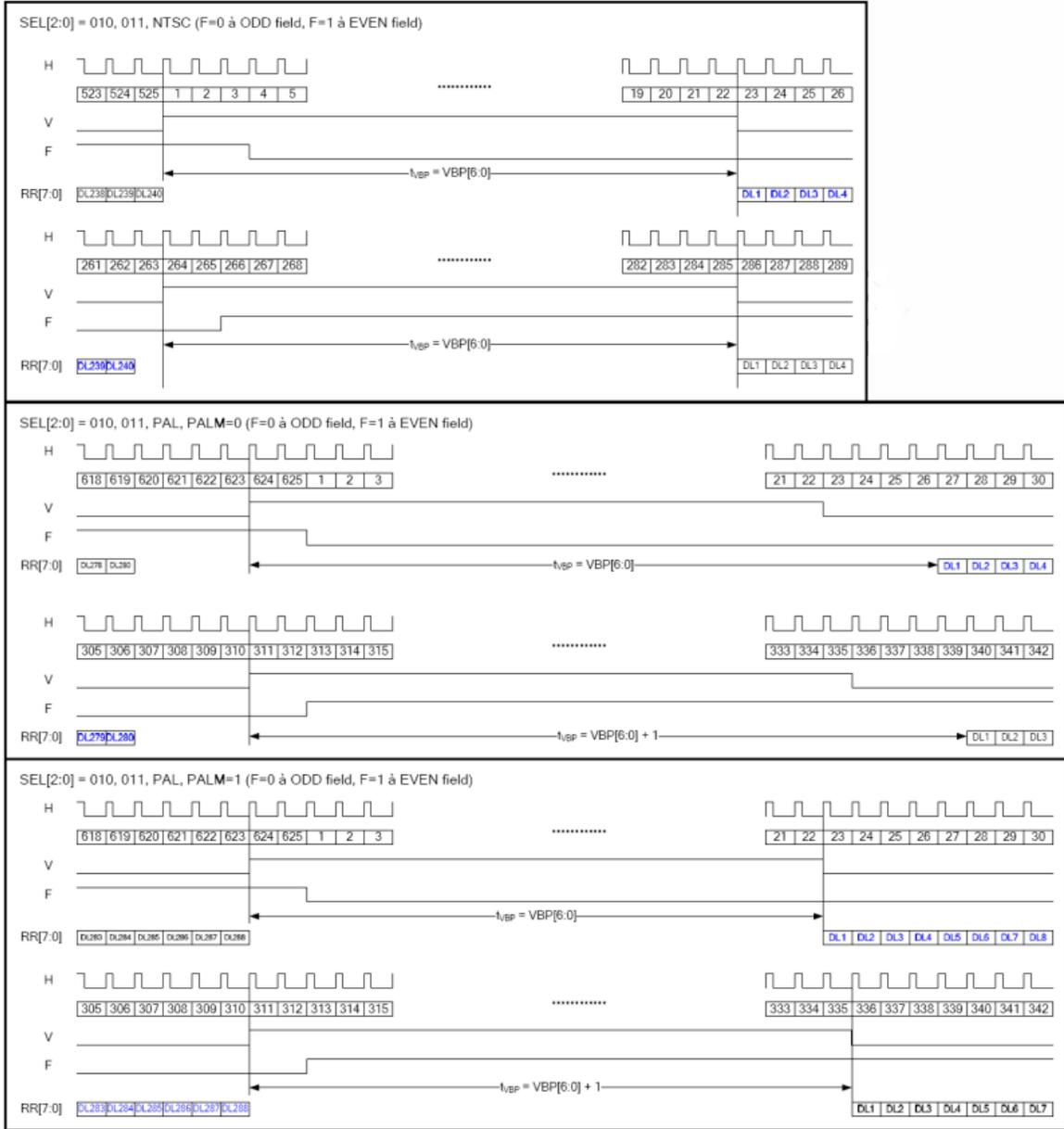
**11.1.3 SPI Interface**

| Characteristics             | Symbol | Min. | Typ. | Max. | Unit |
|-----------------------------|--------|------|------|------|------|
| Serial Clock Frequency      | fclk   | -    | -    | 20   | MHz  |
| Serial Clock Cycle Time     | tclk   | 50   | -    | -    | ns   |
| Clock Low Width             | tsl    | 25   | -    | -    | ns   |
| Clock High Width            | tsh    | 25   | -    | -    | ns   |
| Clock Rising Time           | trs    | -    | -    | 30   | ns   |
| Clock Falling Time          | tfl    | -    | -    | 30   | ns   |
| Chip Select Setup Time      | tcss   | 0    | -    | -    | ns   |
| Chip Select Hold Time       | tcsh   | 10   | -    | -    | ns   |
| Chip Select High Delay Time | tcsd   | 20   | -    | -    | ns   |
| Data Setup Time             | tds    | 5    | -    | -    | ns   |
| Data Hold Time              | tdh    | 10   | -    | -    | ns   |

**11.2 Waveform**



**CCIR656 Horizontal Timing**

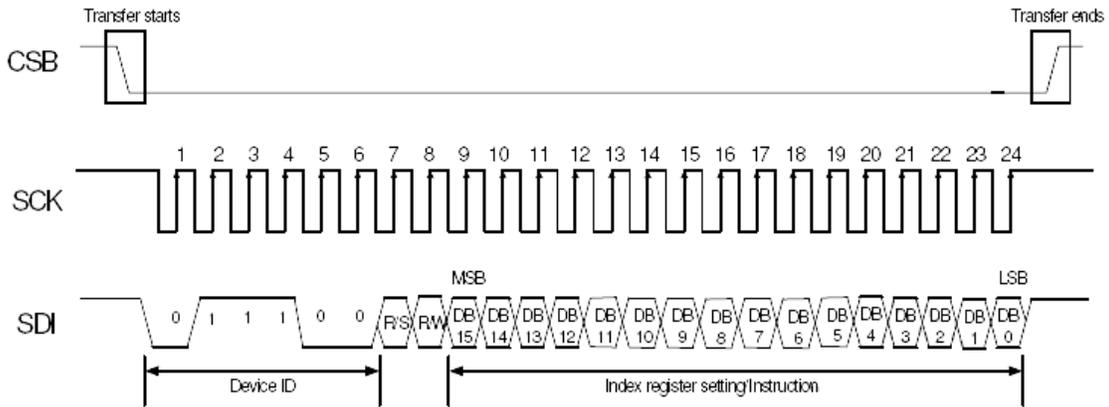


**CCIR656 Vertical Timing**

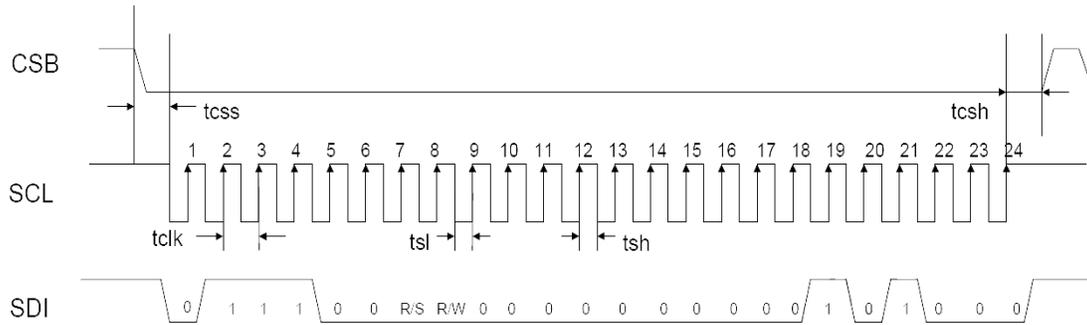


**11.3 SPI**

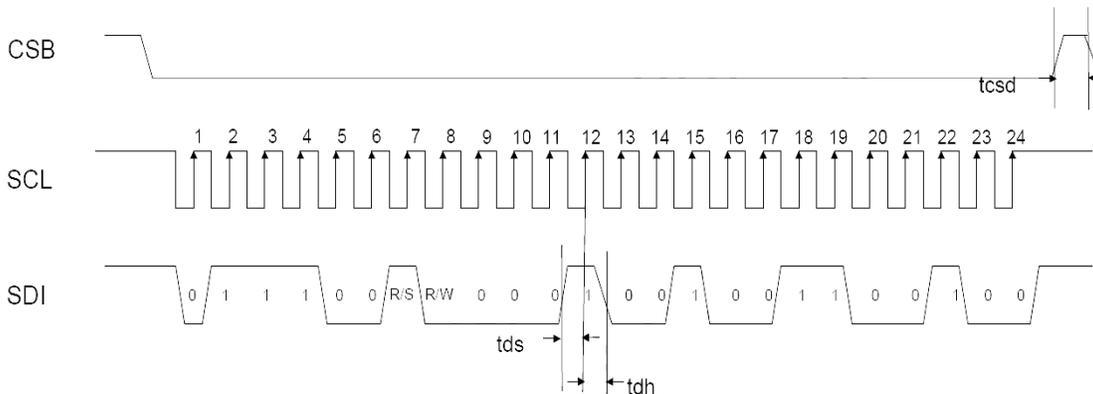
| R/S | R/W | status            |
|-----|-----|-------------------|
| 0   | 0   | Write SPI address |
| 1   | 0   | Write SPI data    |
| 1   | 1   | Read SPI data     |



**First Transmission (Register)**

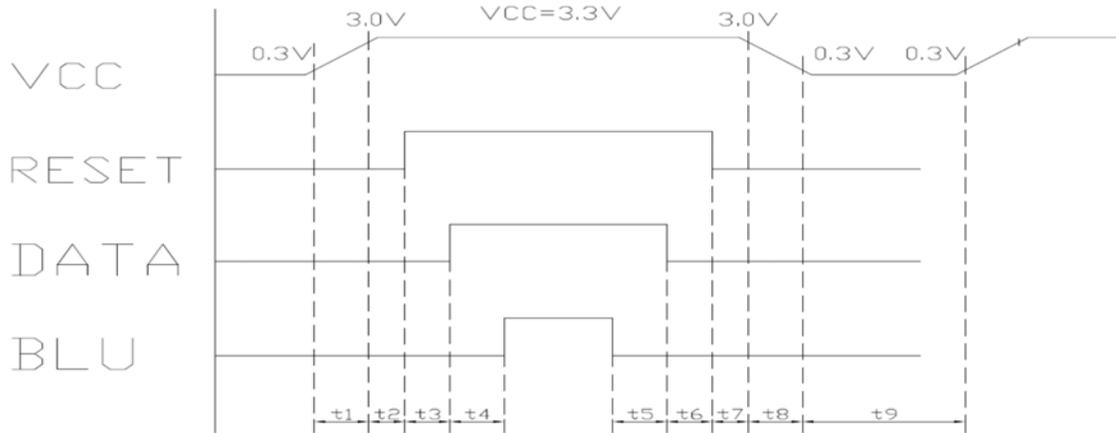


**Second Transmission (Data)**





### 11.4 Power On / Off Sequence



- |                   |                   |                  |
|-------------------|-------------------|------------------|
| $T1 \leq 10ms$    | $200ms \leq T5$   | $1\ sec \leq T9$ |
| $10\mu s \leq T2$ | $50ms \leq T6$    |                  |
| $50ms \leq T3$    | $10\mu s \leq T7$ |                  |
| $200ms \leq T4$   | $T8 \leq 10ms$    |                  |



**12. Instruction Description**

**SPI Command Table**

| Reg# | Register                      | R/W      | R/S | IB15  | IB14  | IB13  | IB12   | IB11   | IB10   | IB9    | IB8    | IB7   | IB6  | IB5  | IB4  | IB3    | IB2    | IB1    | IB0    |
|------|-------------------------------|----------|-----|-------|-------|-------|--------|--------|--------|--------|--------|-------|------|------|------|--------|--------|--------|--------|
| SR   | Status Read                   | 1        | 0   | L7    | L6    | L5    | L4     | L3     | L2     | L1     | L0     | 0     | 0    | 0    | 0    | 0      | 0      | 0      | 0      |
| R01h | Driver output control         | 0        | 1   | 0     | RL    | REV   | PINV   | BGR    | SM     | TB     | CPE    | 0     | 0    | 0    | 0    | 0      | 0      | 0      | 0      |
| R02h | LCD driver AC control         | 0        | 1   | 0     | 0     | 0     | 0      | 0      | 0      | B/C    | 0      | 0     | 0    | 0    | 0    | 0      | 0      | 0      | 0      |
| R03h | Power control (1)             | 0        | 1   | DCT3  | DCT2  | DCT1  | DCT0   | BTF    | BT2    | BT1    | BT0    | DC3   | DC2  | DC1  | DC0  | AP2    | AP1    | AP0    | 0      |
| R04h | Data and color filter control | 0        | 1   | 0     | 0     | 0     | 0      | 0      | PALM   | BLT1   | BLT0   | OEA1  | OEA0 | SEL2 | SEL1 | SEL0   | SWD2   | SWD1   | SWD0   |
| R05h | Function control              | 0        | 1   | GHN   | XDK   | GDIS  | LPF    | DEP    | CKP    | VSP    | HSP    | DEO   | DIT  | 0    | PWM  | 0      | FB2    | FB1    | FB0    |
| R06h | Reserved                      | Reserved |     |       |       |       |        |        |        |        |        |       |      |      |      |        |        |        |        |
| R07h | Reserved                      | Reserved |     |       |       |       |        |        |        |        |        |       |      |      |      |        |        |        |        |
| R0Ah | Contrast/Brightness control   | 0        | 1   | 0     | BR6   | BR5   | BR4    | BR3    | BR2    | BR1    | BR0    | 0     | 0    | 0    | CON4 | CON3   | CON2   | CON1   | CON0   |
| R0Bh | Frame cycle control           | 0        | 1   | NO1   | NO0   | SDT1  | SDT0   | 0      | EQ2    | EQ1    | EQ0    | 0     | 0    | 0    | 0    | 0      | 0      | 0      | 0      |
| R0Dh | Power control (2)             | 0        | 1   | 0     | VRC2  | VRC1  | VRC0   | 0      | 0      | VDS1   | VDS0   | 0     | 0    | VRH5 | VRH4 | VRH3   | VRH2   | VRH1   | VRH0   |
| R0Eh | Power control (3)             | 0        | 1   | 0     | 0     | 1     | VDV6   | VDV5   | VDV4   | VDV3   | VDV2   | VDV1  | VDV0 | 0    | 0    | 0      | 0      | 0      | 0      |
| R0Fh | Gate scan starting Position   | 0        | 1   | 0     | 0     | 0     | 0      | 0      | 0      | 0      | 0      | SCN7  | SCN6 | SCN5 | SCN4 | SCN3   | SCN2   | SCN1   | SCN0   |
| R16h | Horizontal Porch              | 0        | 1   | XLIM8 | XLIM7 | XLIM6 | XLIM5  | XLIM4  | XLIM3  | XLIM2  | XLIM1  | XLIM0 | 0    | 0    | 0    | 0      | 0      | 0      | 0      |
| R17h | Vertical Porch                | 0        | 1   | STH1  | STH0  | HBP6  | HBP5   | HBP4   | HBP3   | HBP2   | HBP1   | HBP0  | VBP6 | VBP5 | VBP4 | VBP3   | VBP2   | VBP1   | VBP0   |
| R1Eh | Power control (4)             | 0        | 1   | 0     | 0     | 0     | 0      | 0      | 0      | 0      | 0      | nOTP  | VCM6 | VCM5 | VCM4 | VCM3   | VCM2   | VCM1   | VCM0   |
| R27h | Reserved                      | Reserved |     |       |       |       |        |        |        |        |        |       |      |      |      |        |        |        |        |
| R28h | Reserved                      | Reserved |     |       |       |       |        |        |        |        |        |       |      |      |      |        |        |        |        |
| R29h | Reserved                      | Reserved |     |       |       |       |        |        |        |        |        |       |      |      |      |        |        |        |        |
| R2Bh | Reserved                      | Reserved |     |       |       |       |        |        |        |        |        |       |      |      |      |        |        |        |        |
| R30h | γ control (1)                 | 0        | 1   | 0     | 0     | 0     | 0      | 0      | PKP 12 | PKP 11 | PKP 10 | 0     | 0    | 0    | 0    | 0      | PKP 02 | PKP 01 | PKP 00 |
| R31h | γ control (2)                 | 0        | 1   | 0     | 0     | 0     | 0      | 0      | PKP 32 | PKP 31 | PKP 30 | 0     | 0    | 0    | 0    | 0      | PKP 22 | PKP 21 | PKP 20 |
| R32h | γ control (3)                 | 0        | 1   | 0     | 0     | 0     | 0      | 0      | PKP 52 | PKP 51 | PKP 50 | 0     | 0    | 0    | 0    | 0      | PKP 42 | PKP 41 | PKP 40 |
| R33h | γ control (4)                 | 0        | 1   | 0     | 0     | 0     | 0      | 0      | PRP 12 | PRP 11 | PRP 10 | 0     | 0    | 0    | 0    | 0      | PRP 02 | PRP 01 | PRP 00 |
| R34h | γ control (5)                 | 0        | 1   | 0     | 0     | 0     | 0      | 0      | PKN 12 | PKN 11 | PKN 10 | 0     | 0    | 0    | 0    | 0      | PKN 02 | PKN 01 | PKN 00 |
| R35h | γ control (6)                 | 0        | 1   | 0     | 0     | 0     | 0      | 0      | PKN 32 | PKN 31 | PKN 30 | 0     | 0    | 0    | 0    | 0      | PKN 22 | PKN 21 | PKN 20 |
| R36h | γ control (7)                 | 0        | 1   | 0     | 0     | 0     | 0      | 0      | PKN 52 | PKN 51 | PKN 50 | 0     | 0    | 0    | 0    | 0      | PKN 42 | PKN 41 | PKN 40 |
| R37h | γ control (8)                 | 0        | 1   | 0     | 0     | 0     | 0      | 0      | PRN 12 | PRN 11 | PRN 10 | 0     | 0    | 0    | 0    | 0      | PRN 02 | PRN 01 | PRN 00 |
| R3Ah | γ control (9)                 | 0        | 1   | 0     | 0     | 0     | VRP 14 | VRP 13 | VRP 12 | VRP 11 | VRP 10 | 0     | 0    | 0    | 0    | VRP 03 | VRP 02 | VRP 01 | VRP 00 |
| R3Bh | γ control (10)                | 0        | 1   | 0     | 0     | 0     | VRN 14 | VRN 13 | VRN 12 | VRN 11 | VRN 10 | 0     | 0    | 0    | 0    | VRN 03 | VRN 02 | VRN 01 | VRN 00 |

Note: \* means don't care

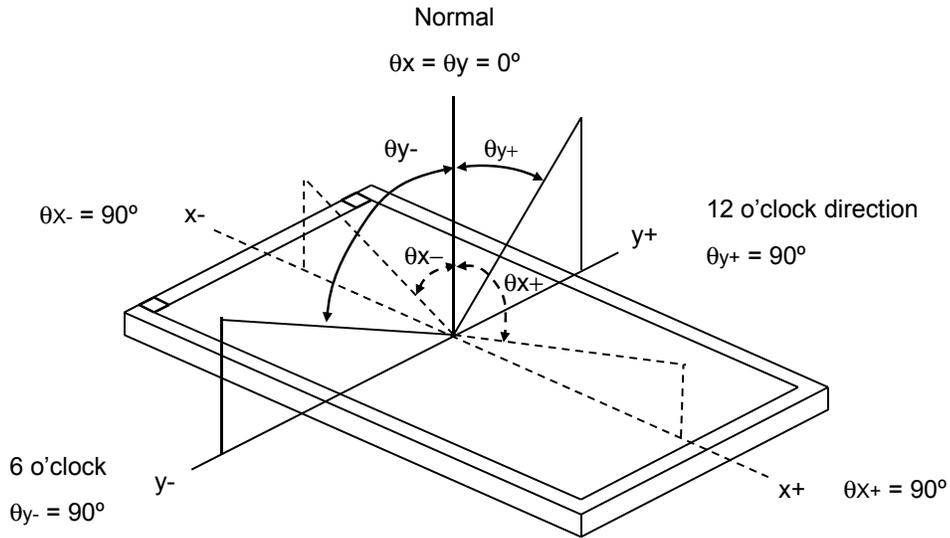
**13. Optical Characteristics**

The optical characteristics should be measured in a dark environment ( $\leq 1$  lux) or equivalent state with the methods shown in Note (5).

| Item                  | Symbol     | Conditions  | Min.           | Typ.  | Max.  | Unit              | Note    |         |
|-----------------------|------------|---|----------------|-------|-------|-------------------|---------|---------|
| Contrast Ratio        | CR         | $\theta_x=0^\circ, \theta_y=0^\circ$<br>Viewing Normal<br>Angle | 150            | (350) | -     | -                 | (2),(5) |         |
| Response Time         | $T_R+T_F$  |   | -              | 50    | -     | ms                | (3)     |         |
| Luminance(Center)     | Y          |   | 250            | (350) | -     | cd/m <sup>2</sup> | (4),(5) |         |
| Brightness uniformity | BUNI       |   | 80             | -     | -     | %                 | (5),(6) |         |
| Color<br>Chromaticity | Red        |   | R <sub>x</sub> | 0.566 | 0.616 | 0.666             | (1),(5) | (1),(4) |
|                       |            |   | R <sub>y</sub> | 0.293 | 0.343 | 0.393             | -       |         |
|                       | Green      |   | G <sub>x</sub> | 0.254 | 0.305 | 0.354             | -       |         |
|                       |            |   | G <sub>y</sub> | 0.547 | 0.597 | 0.647             | -       |         |
|                       | Blue       | B <sub>x</sub>  | 0.088          | 0.138 | 0.188 | -                 |         |         |
|                       |            | B <sub>y</sub>  | 0.045          | 0.095 | 0.145 | -                 |         |         |
|                       | White      | W <sub>x</sub>  | 0.247          | 0.297 | 0.347 | -                 |         |         |
|                       |            | W <sub>y</sub>  | 0.292          | 0.342 | 0.392 | -                 |         |         |
| Viewing Angle         | Horizontal | $\theta_{x+}$   | 55             | (70)  | -     | deg.              |         |         |
|                       |            | $\theta_{x-}$   | 55             | (70)  | -     |                   |         |         |
|                       | Vertical   | $\theta_{y+}$   | 40             | (55)  | -     |                   |         |         |
|                       |            | $\theta_{y-}$   | 50             | (70)  | -     |                   |         |         |



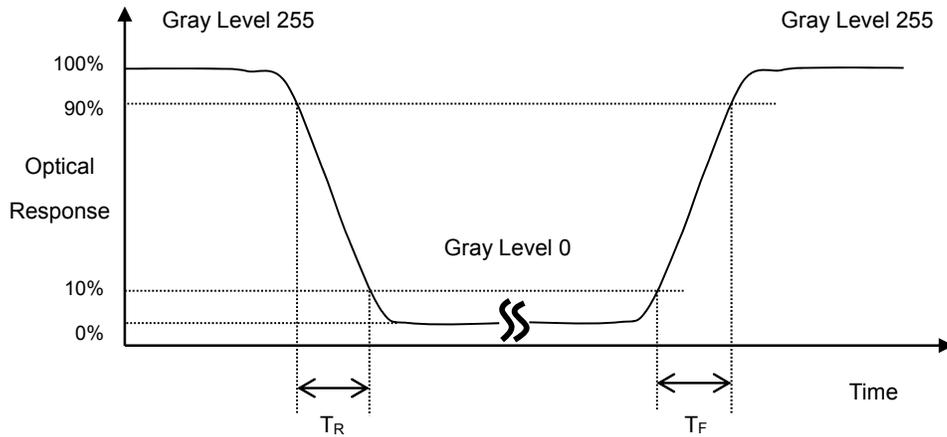
Note (1) Definition of Viewing Angle ( $\theta_x, \theta_y$ ):



Note (2) Definition of Contrast Ratio (CR):

$$CR = \frac{\text{Luminance (brightness) all pixels "White"}}{\text{Luminance (brightness) all pixels "dark"}}$$

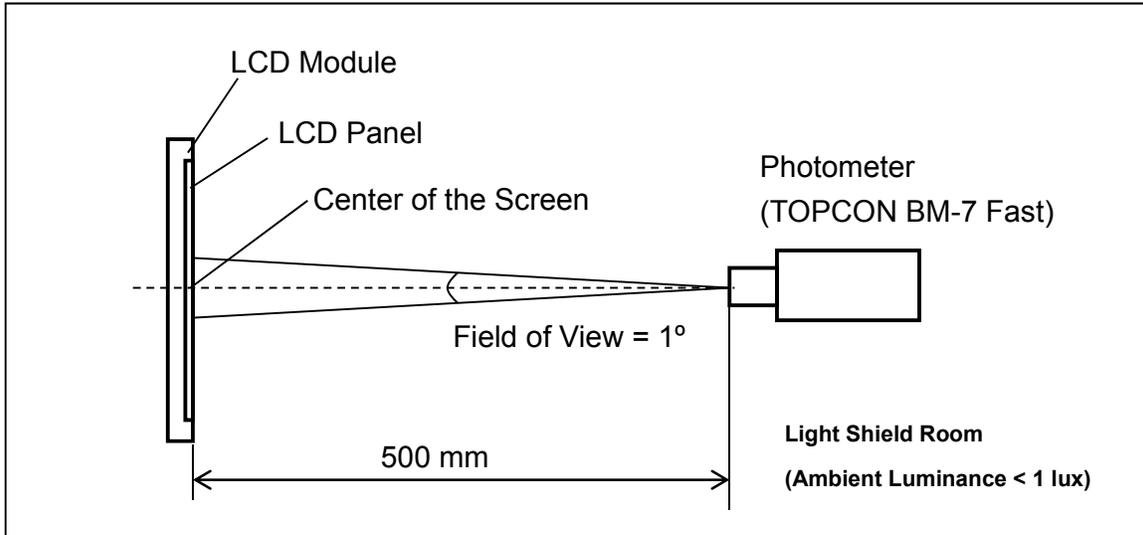
Note (3) Definition of Response Time ( $T_R, T_F$ ):





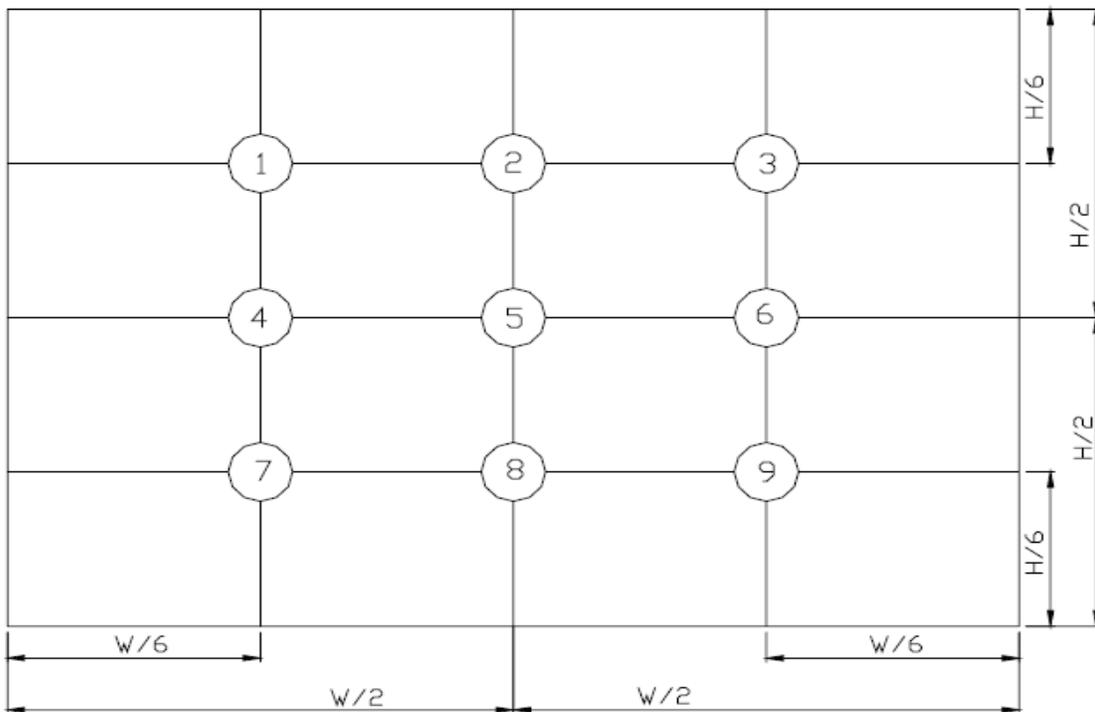
Note (4) Measurement Set-Up:

The LCD module should be stabilized at a given temperature for 30 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 30 minutes in a windless room.



Note (5) Definition of brightness uniformity

$$\text{Brightness uniformity} = (\text{Min Luminance of 9 points}) / (\text{Max Luminance of 9 points}) \times 100\%$$



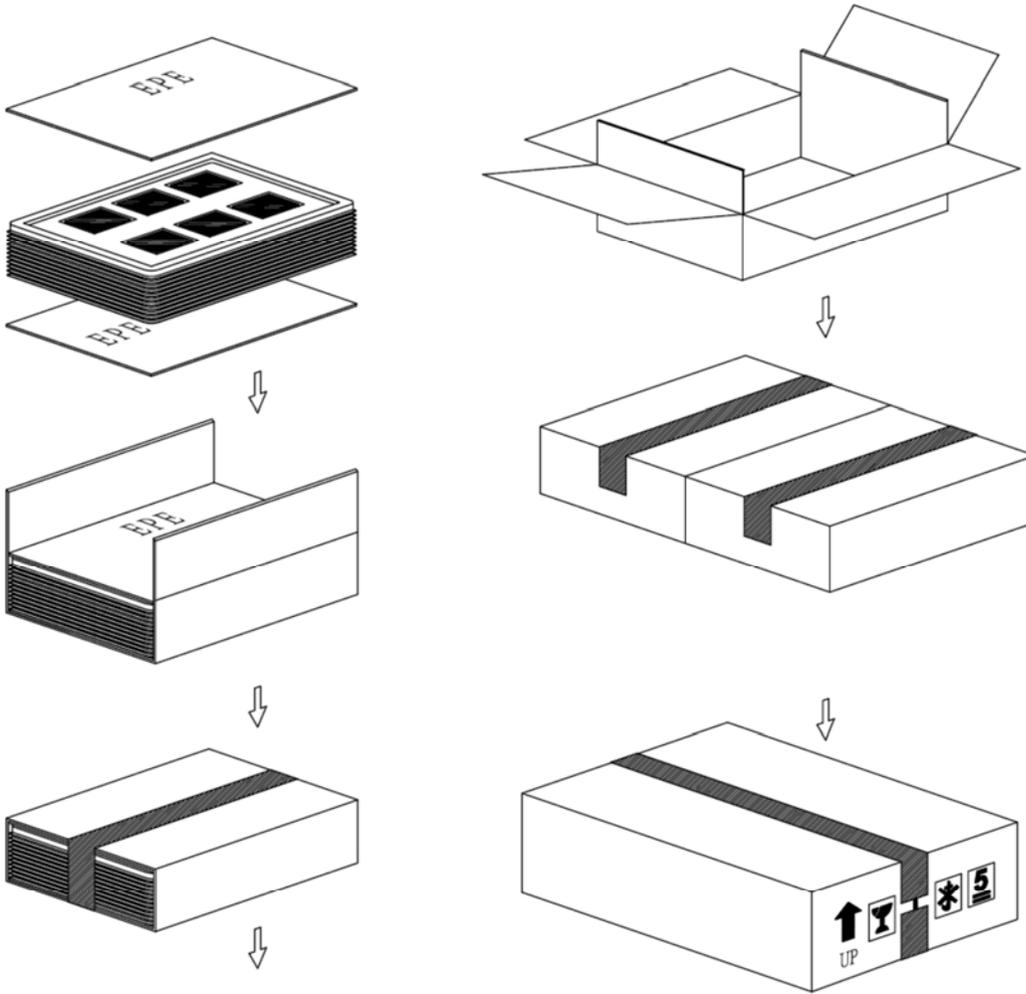
**14. Reliability Test**

| No. | Test Items  | Test Condition  | Remark |
|-----|---|---|--------|
| 1   | High Temperature Storage Test                     | T <sub>a</sub> = 80°C 240 hours                                       | -      |
| 2   | Low Temperature Storage Test                      | T <sub>a</sub> = -30°C 240 hours                                      | -      |
| 3   | High Temperature Operation Test                   | T <sub>a</sub> = 70°C 240 hours                                       | -      |
| 4   | Low Temperature Operation Test                    | T <sub>a</sub> = -20°C 240 hours                                      | -      |
| 5   | High Temperature and High Humidity Operation Test | T <sub>a</sub> =60°C 90%RH 240 hours                                  | -      |
| 6   | Electro Static Discharge Test (non-operating)     | -Panel Surface/Top Case<br>: 150pF, 330Ω<br>Air: ±15kV, Contact: ±8kV | -      |
| 7   | Mechanical Shock Test (non-operating)             | Half sine wave,<br>100G, 6ms<br>3 times shock of each six surfaces    | -      |
| 8   | Vibration Test (non-operating)                    | Sine wave, 10 ~ 55 ~ 10Hz,<br>3 axis, 2 hours/axis                    | -      |
| 9   | Thermal Shock Test (non-operating)                | -20°C(30min) ~ 70°C(30min),100 cycles                                 | -      |
| 10  | Drop Test(with Carton)                            | Height: 80cm<br>1 corner, 3 edges, 6 surfaces                         | -      |



### 15. Packaging

Packing Method



| PARTS LIST |                   |                     |          |       |      |
|------------|-------------------|---------------------|----------|-------|------|
|            | ITEM              | SIZE(LxWxH) unit:mm | MATERIAL | Q.T.Y | NOTE |
| 1          | TRAY              | 372.0x262.0x16.0    | PS       | 28    |      |
| 2          | CARD BOARD(P01)   | 816.0x375.0x3.5     | CARTON   | 2     |      |
| 3          | CARD BOARD(P02)   | 945.0x275.0x3.5     | CARTON   | 2     |      |
| 4          | CARD BOARD(P03)   | 375.0x265.0x3.5     | CARTON   | 4     |      |
| 5          | INTERNAL BOX(S01) | 400.0x290.0x150.0   | CARTON   | 2     |      |
| 6          | EXTERNAL BOX(L02) | 600.0x420.0x170.0   | CARTON   | 1     |      |
| 7          | PRODUCT           | 76.9x63.9x4.4       |          | 156   |      |



## **16. Precautions**

### **16.1 Assembly and Handling Precautions**

- (1) Do not apply rough force such as bending or twisting to the module during assembly.
- (2) It's recommended to assemble or to install a module into the user's system in clean working areas. The dust and oil may cause electrical short or worsen the polarizer.
- (3) Don't apply pressure or impulse to the module to prevent the damage of LCD panel and Backlight.
- (4) Always follow the correct power-on sequence when the LCD module is turned on. This can prevent the damage and latch-up of the CMOS LSI chips.
- (5) Do not plug in or pull out the I/F connector while the module is in operation.
- (6) Do not disassemble the module.
- (7) Use a soft dry cloth without chemicals for cleaning, because the surface of polarizer is very soft and easily scratched.
- (8) Moisture can easily penetrate into LCD module and may cause the damage during operation.
- (9) High temperature or humidity may deteriorate the performance of LCD module. Please store LCD module in the specified storage conditions.
- (10) When ambient temperature is lower than 10°C, the display quality might be reduced. For example, the response time will become slow.

### **16.2 Safety Precautions**

- (1) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, skin or clothes, it has to be washed away thoroughly with soap.
- (2) After the module's end of life, it is not harmful in case of normal operation and storage.

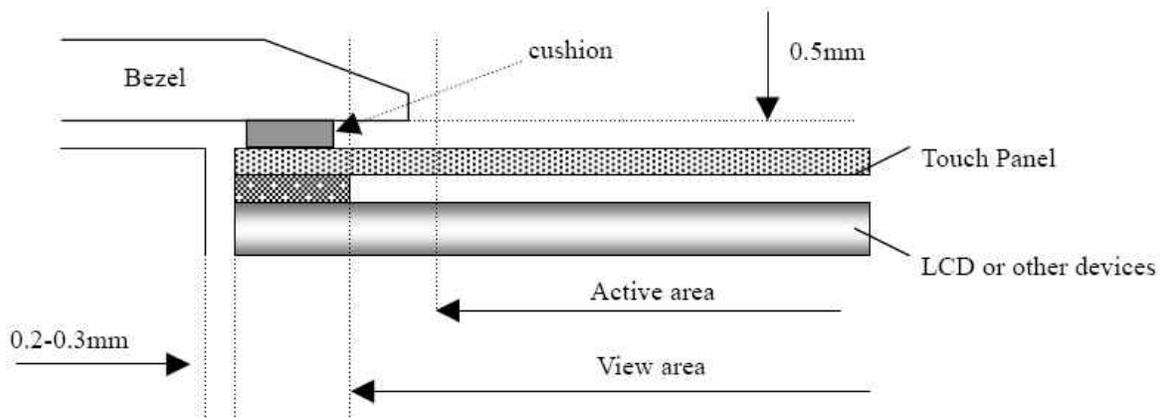
### **16.3 Terms of Warrant**

- (1) Acceptance inspection period  
The period is within one month after the arrival of contracted commodity at the buyer's factory site.
- (2) Applicable warrant period  
The period is within twelve months since the date of shipping out under normal using and storage conditions.



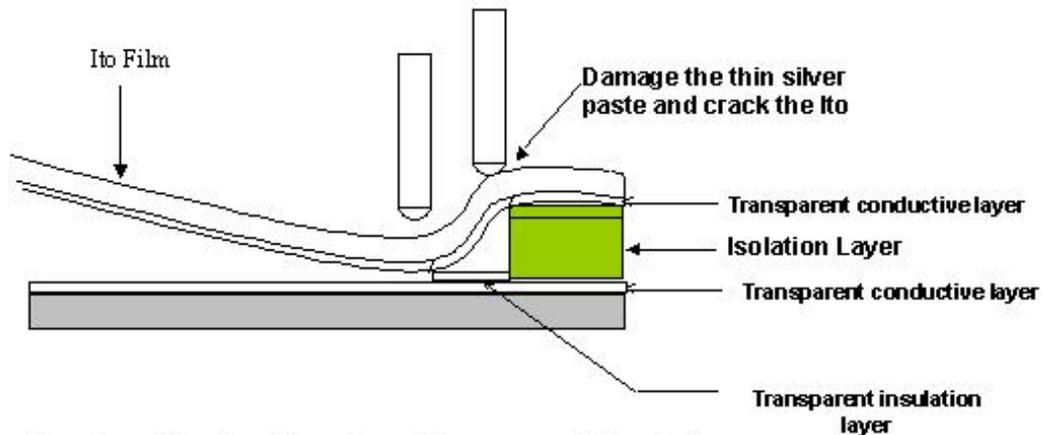
### 16.4 Cautions for installing and assembling

Bezel edge must be positioned in the area between the Active area and View area. The bezel may press the touch screen and cause activation if the edge touches the active area. A gap of approximately 0.5mm is needed between the bezel and the top electrode. It may cause unexpected activation if the gap is too narrow. There is a tolerance of 0.2 to 0.3mm for the outside dimensions of the touch panel and tail. A gap must be made to absorb the tolerance in the case and connector.



### 16.5 Operation Prohibit

#### Not Suggested Pen Input Position On Touch Panel

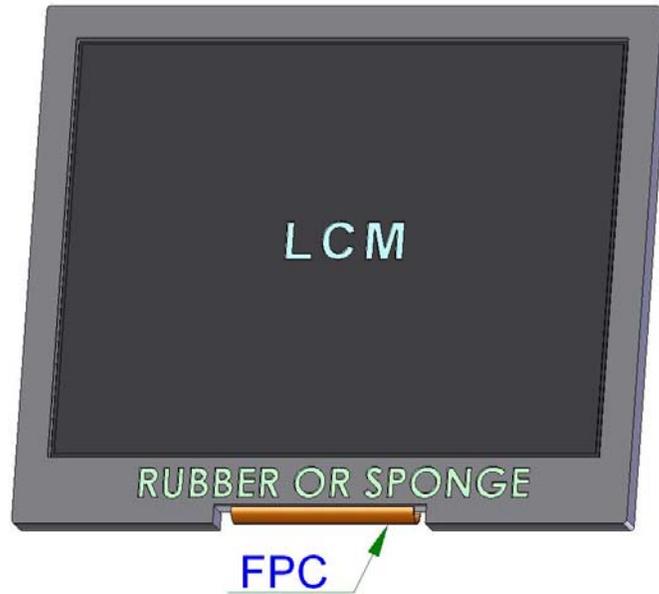


Pen input load on the edge of transparent insulation area might damage the ITO of ITO Pet- Film and reduce the durability of touch panel



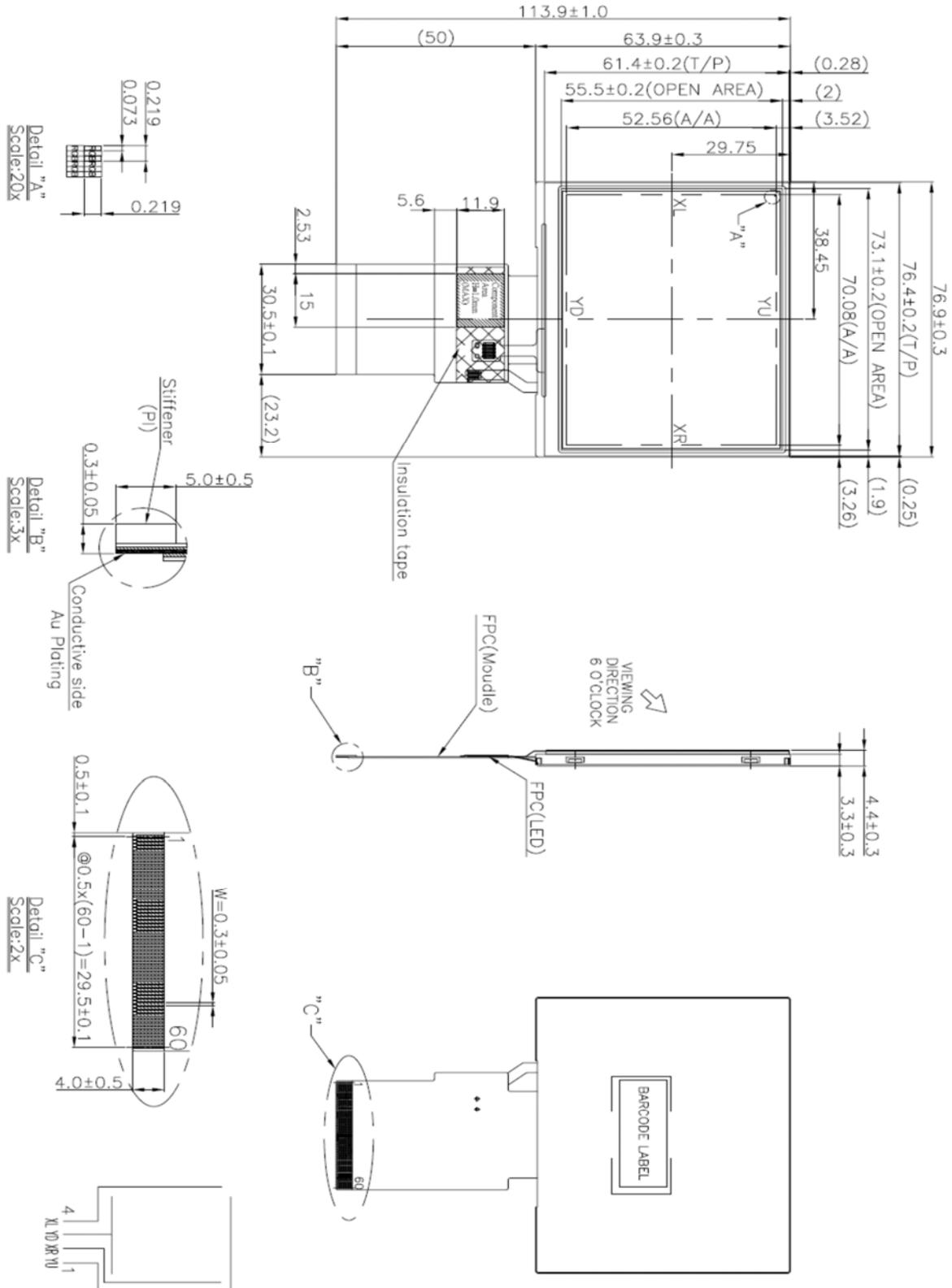
### 16.6 Cautions for LCM's installing and assembling

Please keep away the FPC while assembling or fixing the LCM to avoid FPC being damaged or extruded or other related problems. Please see below picture.





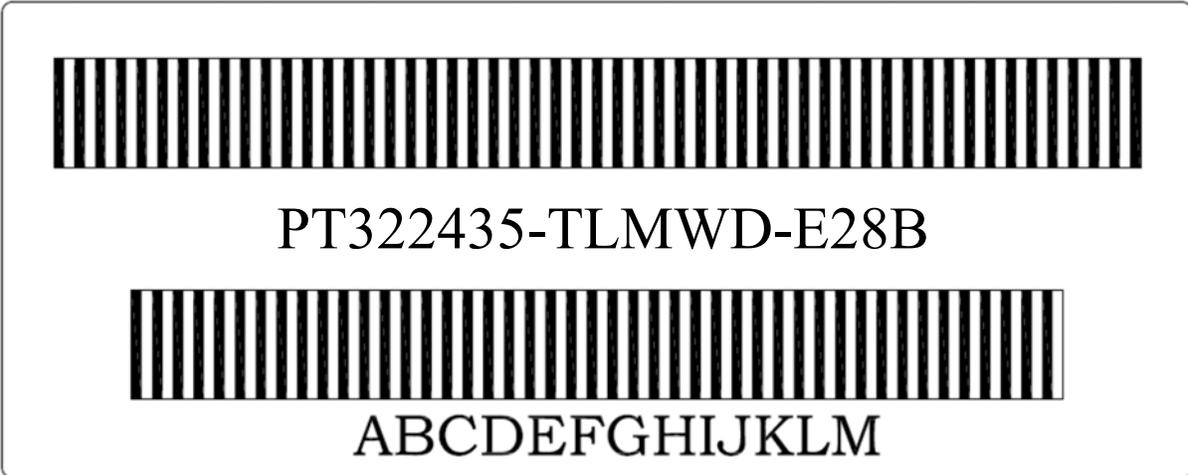
**17.Outline Drawing**





**18. Definition of Labels**

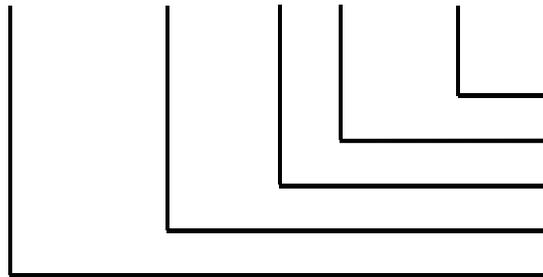
The bar code nameplate is pasted on each module as illustration, and its definitions are as following explanation.



(a) Module Name: PT322435-TLMWD-E28B

(b) Serial ID:

A B C D E F G H I J K L M



Serial No.  
Revision Code  
Factory Code  
Manufactured Date  
Screen Size

Serial ID includes the information as below:

(a) Screen size (Diagonal): Inch Code (ABCD)

3.5" → 0350

10.4" → 1040

(b) Manufactured Date: Year, Month, Day (EFG)

Year (E)

|      |      |      |      |      |      |      |      |      |      |      |
|------|------|------|------|------|------|------|------|------|------|------|
| Year | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
| Mark | 0    | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    |
| Year | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
| Mark | A    | B    | C    | D    | E    | F    | G    | H    | I    | J    |



Month (F)

|       |      |      |      |      |     |      |      |      |      |      |      |      |
|-------|------|------|------|------|-----|------|------|------|------|------|------|------|
| Month | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. |
| Mark  | 1    | 2    | 3    | 4    | 5   | 6    | 7    | 8    | 9    | A    | B    | C    |

Day (G)

|      |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Day  | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| Mark | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | A  | B  | C  | D  | E  | F  | G  |
| Day  | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |    |
| Mark | H  | I  | J  | K  | L  | M  | N  | O  | P  | Q  | R  | S  | T  | U  | V  |    |

(c) Factory Code (H):

For P-TEC internal use.

(d) Revision Code (I):

Cover all the change, for example: 1: Rev.1, 2: Rev.2, 3: Rev.3...etc.

(e) Serial No. (JKLM):

Manufacturing sequence of product, for example: 0001~9999.

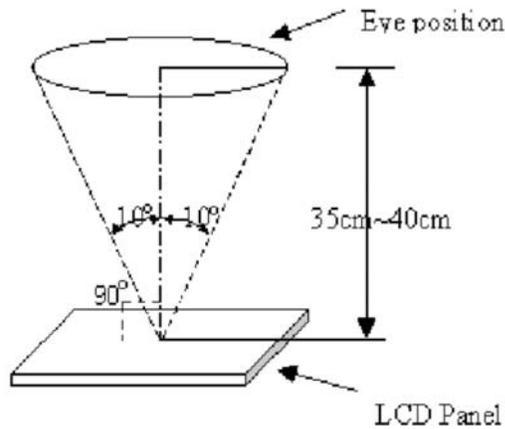


**19. Incoming Inspection Standards**

**19.1 The environmental condition of inspection**

The environmental condition and visual inspection shall be conducted as below.

- (1) Ambient temperature  $25 \pm 5^{\circ}\text{C}$
- (2) Humidity:  $60 \pm 5\% \text{ RH}$
- (3) Viewing distance is approximately 35 ~ 40 cm
- (4) Viewing angle is normal to the LCD panel as Fig\_1( $10^{\circ}$ )
- (5) Ambient Illumination: 300 ~ 500 Lux for external appearance inspection



**Fig\_1**

**19.2 The defects classify of AQL as following:**

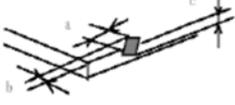
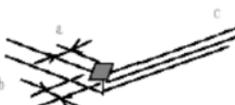
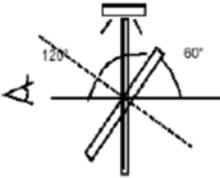
| Class of defects | AQL   | Definition   |
|------------------|-------|--|
| Major            | 0.65% | It is defect that is likely to result in failure or to reduce materially the usability of the intended function. |
| Minor            | 1.5%  | It is a defect that will not result in functioning problem with deviation classified.                            |



**19.3 Inspection Parameters**

| Item                                   |   | Specification/Description  |                   |                   | Note       |                      |
|--|---|--|-------------------|-------------------|------------|----------------------|
| Display                                | Function  | No Display   |                   |                   | -          |                      |
|  |   | Malfunction  |                   |                   | -          |                      |
| Operating                              | Contrast ratio                                  | Out of Spec  |                   |                   | -          |                      |
|  | Line defect                                     | No obvious Vertical and Horizontal line defect in bright , dark and colored. |                   |                   | -          |                      |
|  | Point Defect<br>(red,green,blue,dark,<br>white) | Item   | Acceptable number |                   |            | Note:<br>1、4、<br>5、6 |
|  |   |  | A                 | B                 | Total      |                      |
|  |   | BRIGHT DOT   | $N \leq 0$        | $N \leq 2$        | $N \leq 6$ |                      |
|  |   | DARK DOT   | $N \leq 2$        | $N \leq 4$        |            |                      |
|  |   | TOTAL DOT  | $N \leq 2$        | $N \leq 4$        |            |                      |
|  |   | TWO ADJACENT DOT   | NOT ALLOWED       |                   |            |                      |
| THREE OR MORE ADJACENT DOT             | NOT ALLOWED                                     |  |                   |                   |            |                      |
| External Inspection<br>(non-operating) | Scratch on the polarizer                        | L(mm)  | W(mm)             | Acceptable number | Note:2     |                      |
|  |   | $L \leq 2.5$   | $W \leq 0.1$      | 3                 |            |                      |
|  |   | $L > 2.5$  | $W > 0.1$         | 0                 |            |                      |
|  | Dent or bubble on the polarizer                 | Dimension(mm)  |                   | Acceptable number |            | Note:3               |
|  |   | $D \leq 0.3$   |                   | 3                 |            |                      |
|  |   | $D \leq 0.1$   |                   | Disregard         |            |                      |
|  | Foreign material on the polarizer               | Dimension(mm)  |                   | Acceptable number |            | Note:3               |
|  |   | $D \leq 0.5$   |                   | 2                 |            |                      |
|  |   | $D \leq 0.1$   |                   | Disregard         |            |                      |

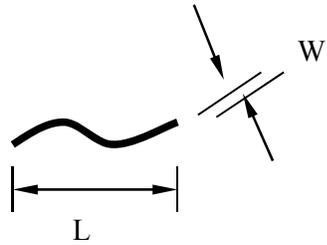


| Item           |   | Specification/Description |  |   | Note   |   |
|----------------|---|---------------------------|--|---|--------|---|
| Touch Panel    | Scratch   | L(mm)                     | W(mm)  | Acceptable number                                 | Note:2 |   |
|                |   | L ≤ 10                    | W < 0.05   | Disregard   |        |   |
|                |   |                           | 0.05 ≤ W < 0.1                                     | N ≤ 4   |        |   |
|                |   |                           | W ≥ 0.1  | 0   |        |   |
|                | Foreign Materials<br>(Linear shape)   | L ≤ 10                    | W < 0.05   | Disregard   | Note:2 |   |
|                |   |                           | 0.05 ≤ W < 0.1                                     | N ≤ 3   |        |   |
|                |   |                           | W ≥ 0.1  | 0   |        |   |
|                | Foreign Materials<br>(Circular shape)   | Dimension(mm)             |  | Acceptable number                                 | Note:3 |   |
|                |   | D ≤ 0.25                  |  | Disregard   |        |   |
|                |   | 0.25 < D ≤ 0.5            |  | N ≤ 6   |        |   |
| D > 0.5        |   | 0                         |  |   |        |   |
| Glass chipping |    |                           |  | a ≤ 5.0mm<br>b ≤ 3.0mm<br>c ≤ t (t : Glass think) | Note:7 |   |
|                |    |                           |  |   |        | a ≤ 3.0mm<br>b ≤ 3.0mm<br>c ≤ t (t : Glass think) |
| Newton-ring    | (In case of doubtful situations)<br>Observe on 60° from the product surface under a while Fluorescent lamp (3-wavelength lamp). |                           | Average diameter ≤ 1/3 Touch Panel area Disregard. |   | Note:7 |   |
|                |    |                           |  |   |        |   |
| Membrane Drum  |    |                           |  | H ≤ 0.3mm   |        |   |

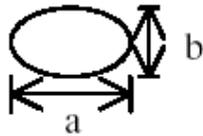


Note1. The definition of dot defect : The dot defect was judged after repair and the size of a defective dot over 1/2 of whole dot is regarded as one defective dot.

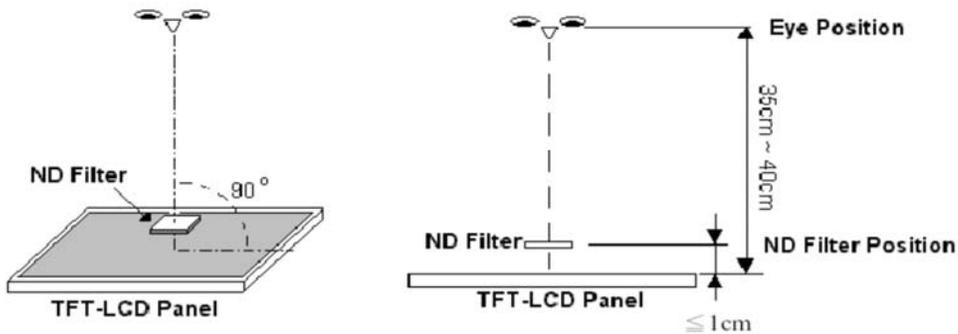
Note2.



Note3. D : Diameter  $D=(a+b)/2$



Note4. Bright dot is defined through 6% transmission ND Filter as following.

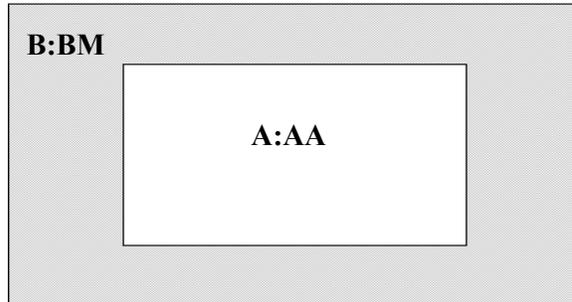


Note5. ADJACENT DOT

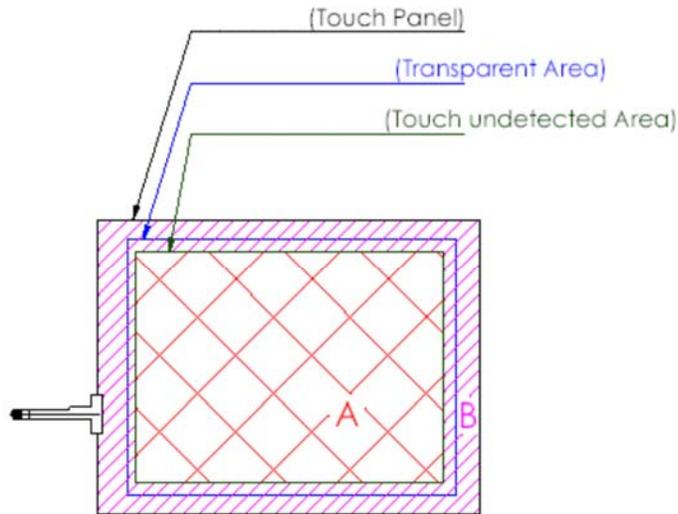




Note6.



Note7.



A area : Without any defect point effect on normal operation.

B area : None-specify

### 19.4 Handling of LCM

- (1) Don't give external shock.
- (2) Don't apply excessive force on the surface.
- (3) Liquid in LCD is hazardous substance. Must not lick and swallow. when the liquid is attach to your hand, skin, cloth etc. Wash it out thoroughly and immediately.
- (4) Don't operate it above the absolute maximum rating.
- (5) Don't disassemble the LCM.